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# Speed and Road Accidents: Behaviors, Motives, and Assessment of the Effectiveness of Penalties for Speeding

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**Abstract** When dealing with the duality of mobility and safety, speed is one of the main factors causing deaths, so this is the reason why speed is one of the most studied topics related to road safety. The main objective of this research was to identify the aspects that modulate the speed-accidents relation. Specifically, the frequency and reasons why drivers speed. On the other hand, it was also considered the perception of drivers regarding the probability of penalty, the penalties imposed, and their severity. Finally, drivers' opinion on the effectiveness of such penalty in order to change speeding behavior was also studied. A sample of 1,100 Spanish drivers over 14 years old and having any kind of driving license was used. The results showed that approximately the third part of drivers *always* or *sometimes* sped. Among the specific reasons, the *hurry*, not *having noticed*, that *the limits are too low* or that *the conditions allow doing so* were the most frequent. Likewise, drivers considered as *limited* the probability of being caught. Finally, more than half of the drivers considered that the penalty they received was *appropriate*. Moreover, half of the drivers that received a penalty claimed that they changed their speeding habits as a result of such penalty. Drivers who speed are completely aware of the fact that they are breaking the traffic rules. Their speeding behavior is intentional in 80% of the cases. They are not aware of the risks of speeding since they justified their behavior by saying the speed limits are too low, the conditions on the roads allow doing so, or that it was a habit.

***Keywords:*** *speed limits, road safety, traffic violation, behavior modification*

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## 1. Introduction

There is wide scientific evidence about the fact that speeding is the factor that most contributes to the risk, severity and fatality of motor vehicle collisions [1,2,3]. Traffic speed strongly influences impact speed in crashes and therefore has major implications for public health [3]. Specifically, the World Health Organization [4] agrees that excessive and inappropriate speed is the main cause of approximately one in every three serious or fatal crashes in the countries with high rates of motor vehicles use. This data is the main reason why most governments consider speeding as a huge problem for road safety.

Speeding is one of the risk factors in traffic and it has a negative impact on the road environment and on the quality of life of people.

Regarding driving, there is wide scientific evidence on the fact that higher speeds increase the time needed to identify and response to a stimulus, the distance travelled by the vehicle until the driver responds to danger or a threat, and the distance required to stop the vehicle, so speeding decreases the probability to prevent a collision [5,6]. In addition, the higher the speed the poorer is the efficiency of the vehicle. Likewise, high speed increases the effects of other drivers' errors, such as distractions or not keeping the appropriate safety distance, so this multiplies the probability of being involved in a traffic crash [6,7].

Speeding is considered as the factor that contributes the most to risk and severity, and, as a consequence, to the mortality related to traffic accidents [1,2]. Almost the third part of deaths (32%) is related to speeding, and the number seems to be increasing over the years [4,8].

In spite of these evidences, the speed-accidents relation is very complex since it is influenced and modulated by many factors, without forgetting the partially random nature of accidents [9]. Among the factors that contribute to the speed-accidents relation, it is worth mentioning: the driver's characteristics (demographic and psychological factors), the main actor [6] , the aspects related to the vehicle, and factors related to the road environment, as well as several cultural factors, since traffic regulations are different from one country to another [7,10].

In any case, from the identification of the factors present in the speed-accidents relation, the Transport Research Laboratory (TRL) proposes to carry out two types of studies on speed: studies based on the road and studies based on the driver [11].

The studies based on the road justify the proposals aimed at reducing speed limits. In this sense, it has been established as a general rule that reducing speed by 1 km/h reduces crashes with injuries by 2-3% [11]; reducing speed by 5 km/h in 60 km/h limit zones reduces crashes by 31%, while the risk of being involved in a crash is six times higher when exceeding speed limits by 20 km/h [12]; and reducing speed by 10 km/h one may expect the mean speed of traffic to go down by about 2.5 km/h so, when mean speed is reduced it almost always reduces the number of crashes and their severity [2].

The studies based on the driver highlight the speed in which drivers decide drive in different types of road when there are speed limit signs in several environmental situations and in traffic conditions. Drivers' decision is influenced by a series of demographic characteristics (age, gender, driving experience, occupation, among others), by a series of psychological aspects or factors (motivations, beliefs, perceptions, attitudes, emotions, driving habits, etc.) as well as by the involvement and responsibility in traffic violations, among others.

From the driver's perspective, the evaluation of the data on the frequency of this behavior suggests that, in general, all drivers sped at some time. Nevertheless, it is much easier to notice other's speeding [13]. Between 66% and 85% of the drivers admit they occasionally exceed the speed limits [14,15]. When it comes to a certain road, between 30-50% of all drivers exceed the speed limits established by the signs [2].

In Spain, drivers state they obey the speed limits even though there is evidence on the fact that the failure to obey these limits is greater in general limits and not in the specific ones, as well as in motorways [16].

Significant information reveals that drivers' speed (regarding the mean speed of traffic on the road) is consistent with the initial speeds, in different parts of the journey, and through different driving tests [17]. In this sense, it is important to understand a relative proportion of drivers exceeding speed limits is relatively constant over the years [8].

Closely related to this aspect is the use of psychological scales, specifically the called *Intentional Offence* scale (used to quantify the self-reported frequency of committing traffic violations); the use of these scales has shown that drivers who drive faster break the traffic rules more frequently [18].

Regarding demographic aspects, studies in different countries have shown that young males are the main risk group when it comes to traffic crashes related to speeding. Drivers under 34 years old are more likely to exceed the speed limits (30 km/h more than the specific speed limit), while from 55 years old on, journeys are more likely to be excessively slow [19]. In this sense, it seems that people around 40 years old are less likely to exceed the speed limits [20,21,22].

Likewise, there is evidence stating that the involvement and the responsibility of the driver in a traffic crash is closely related to age, driving experience, and the kilometers per year. In this sense, the responsibility in a traffic crash decreases in a non-lineal way when the age and experience is higher, and it increases with the number of kilometers travelled. So, the greater the speed, the greater the responsibility rate of the driver in traffic crashes [23]. Therefore, it is possible to observe a risk group made of young drivers and male drivers who drive a great amount of kilometers per year and who are more likely to break the traffic rules than other drivers, and, at the same time, they are also more likely to be involved in a traffic crash [22,24].

In addition, according to the demographic data young people under 25 years old showed a higher probability of being fined for speeding over the last six months (specifically, 14% compared to the 8% of interviewees); in spite of perceiving a lower probability of sanction [25].

Among the motives or reasons why drivers sped, the most common in general is *convenience*. Likewise, drivers who give this reason believe themselves to be safer than other drivers [26]. Other reasons why drivers exceed speed limits are the *hurry* (23%) and *overtake* (16%) [14].

## 1.1. Study Framework

Law, and all its related aspects, has an essential part that comes from legal science. Moreover, law applies to individuals and societies, so it has a lot to do with sociology and psychology. Individuals and societies may or may not know the laws, they may or may not accept them, they may or may not share their principles, and they may or may not obey them. In order for laws to be applied and obeyed, different sciences must be involved when developing them. In addition, the law is not the only thing to take into account; rules make no sense unless there are consequences when they are not obeyed. From this approach, traffic laws have to be treated from a comprehensive perspective.

Moreover, it is important to understand legislation and everything it involves and to regulate drivers' behavior since reckless behavior not only affects the driver itself but other people (drivers and pedestrians on the road). Therefore, it is preserving one's life and the life of others. So, this is why the framework of this article was a large-scale project based on "traffic laws and road safety" to raise people's awareness regarding this matter [10,27].

This global research on traffic laws and road safety used a questionnaire made up of a set of items in different sections. An important aspect of the questionnaire is the order of the questions. The objective of the items was not to influence the answers in a particular direction.

First of all, the questionnaire was used to collect socio-demographic data (such as age, gender, occupation, etc.). In addition, other descriptive factors relevant to road safety were also taken into account in order to classify drivers: main motive of the journey, driving frequency, professional drivers, driving experience, kilometers per year, type of journey, most frequently used type of road, and record of accidents and penalties.

There were also subsections to collect information related to these areas: unsafe/risky behaviors (speeding, inappropriate speed in specific situations, unsafe following distance, shouting or verbally insulting while driving, driving under the influence of alcohol, driving without a seat belt, smoking while driving, driving without insurance, driving without the required vehicle

inspection). It was also interesting to learn about the beliefs, knowledge, and attitudes of participants towards the areas of "legislation", "penalties", "law enforcement", "law and traffic laws", and the "effectiveness of the measures to prevent traffic crashes".

The study described in this article is based on some items of the section "unsafe/risky behaviors", and the "speeding" subsection. In this section of the questionnaire, participants were asked to provide information about speeding: reasons and frequency, risk of speeding, severity of the penalty, estimated probability of penalty, type of penalties, and penalties received (evaluation and effectiveness).

### 1.2. Objectives

The objectives of this research were to identify the frequency in which drivers sped, the reasons why they do it, and the estimated probability of penalty, and to learn about speeding penalties received and their severity. Finally, the effectiveness of the penalty as a measure to change speeding behavior was also studied.

## 2. Materials and Methods

### 2.1. Participants

**Table 1. Total sample distribution according to age and gender**

| Age | Male | Female | Total |
|---|---|---|---|
| 14-17 | 9 | 4 | 13 |
| 18-24 | 61 | 45 | 106 |
| 25-29 | 77 | 64 | 141 |
| 30-44 | 235 | 183 | 418 |
| 45-65 | 218 | 113 | 331 |
| Over 65 | 78 | 13 | 91 |
| Total | 678 | 422 | 1100 |

Participants were part of a wide-ranging research on different aspects of traffic laws and road safety. The sample used was composed of 1,100 Spanish drivers over 14 that had any kind of driving license, 678 men (61.63%) and 422 women (38.36%). The starting sample size was proportional by quota to the Spanish population segments of age and gender. Participants were divided into groups according to age and gender. The gender distribution was closely linked with age; the higher the age, the lower the percentage of women. So, the number of women from 45 onwards decreased, just like it happens with the general population of drivers (Table 1).

The number of participants represents an error margin for the general data of ± 3 with a 95% confidence interval and a level of significance of 0.05.

Drivers completed a telephone-based survey. Interviews were completed for 1,100 drivers and, as it was a survey dealing with social matters, the vast majority of people wanted to collaborate.

### 2.2. Procedure and Design

The survey was conducted by telephone. A national telephone household sample was constructed using random digit dialing. Each household was screened to determine the number of adult (age 14 or older) drivers in the household. The only selection criterion was being in possession of any type of driving license. One eligible driver was systematically selected in each eligible household by the interviewers. The survey was conducted using the computer-assisted telephone interviewing (CATI) system to reduce interview length and minimize recording errors, guaranteeing at all times the anonymity of the participants, and stressing on the fact that the data would only be used for statistical and research purposes. The importance of answering honestly to all the arisen questions was emphasized, as well as the non-existence of wrong or right answers.

Subsequently, drivers were asked about the frequency in which they speed; the possible answers for this question were as follows: *almost always*, *usually*, *sometimes*, *almost never*, and *never*. In order to get more specific information, participants were asked to state the reason why they sped, in case they had. Participants were also asked "*For every 10 times speeding, how many times is this behavior sanctioned?*", and they had to say a number from 0 to 10. Participants were also asked whether they had received a penalty and, if the answer was "yes", they were asked about the severity of such penalty with possible answers: "*excessive*, *appropriate*, or *limited*". In addition, if participants had been punished, they were asked whether the penalty helped to change their speeding behavior.

Once the data was obtained, the relevant statistical analyses were carried out with the Statistical Package for the Social Sciences (SPSS). For the comparison of mean values the unifactorial ANOVA test was used, followed by Bonferroni's post-hoc test. Statistical significance was set at $p < 0.05$.

## 3. Results

The data analysis showed that 7.7% of drivers admitted they *almost always* or *usually* speed. Likewise, 30% stated they *sometimes* speed. Drivers who claimed they *never* or *almost never* speed were more than 60% (Figure 1).

There were significant differences for **gender** ($F(1.1092) = 55.609$, $p \leq 0.05$). Male drivers were the ones who sped more frequently. Young people between 18-24 years are the drivers who speed more frequently. However, from 45 years onwards, the probability of speeding is reduced. Nevertheless, these **age**-related differences were not significant.

Likewise, speeding is related to drivers who usually drive on highways or freeways. However, there were no significant statistical differences or a significant statistical relation between the frequency of speeding and the level of **knowledge** the driver showed on traffic rules.

Among the **reasons why drivers sped** it was fond that *hurry* or *emergency* (27.1%) was the main reason, while the second reason was the lapse of concentration (*I did not realize*) (19.5%). On the other hand, it is important to know that 14.3% of drivers claimed they *intentionally* speed.

Drivers' interpretation or evaluation of the traffic rules is also significant since 15% of drivers considered that the speed limits are *too low* and 13.6% stated that they speed because *the conditions allow doing so*. Finally, 4.3% of drivers claimed that they speed because *everybody does it*,

3.8% see this action as a *habit*, 3.6% did it to *pass cars*, and 2.9% did this because the *power of the current vehicles* allow it (Figure 2).

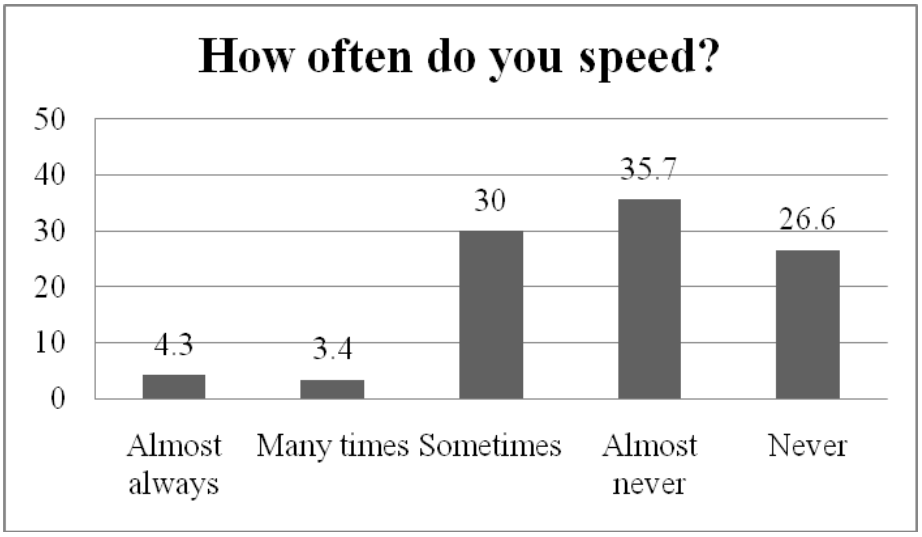


**Figure 1.** Percentage distribution of drivers according to the frequency in which they speed

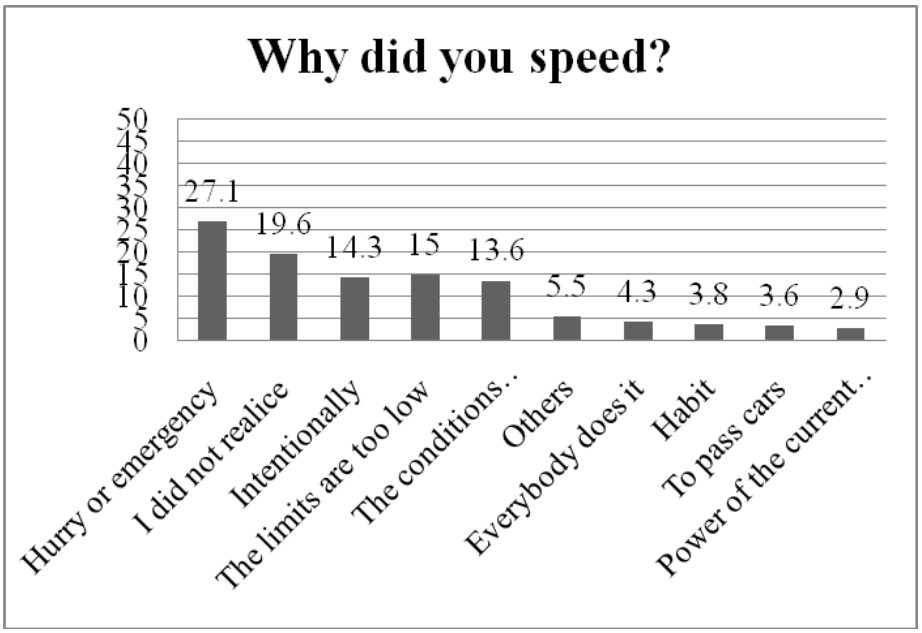


**Figure 2.** Percentage distribution of drivers according to the reasons why they speed

Regarding the **reasons why drivers did not speed**, 36.8% of drivers claimed it was because of the fact that they could be involved in a traffic crash; while 15.9% admitted they do not like speeding. Other reasons for not speeding were as follows: caution and safety, it is prohibited and traffic rules must be followed, it is better to drive with plenty of time than speeding, possibility of penalties, they drive around urban areas or short distances, it is the right thing to do, traffic does not allow it, car does not allow it, not enough experience, possibility of suspension of driving license.

Regarding other aspects, 21.8% of drivers said they had been **sanctioned for speeding at least once**. There were statistical differences between being sanctioned for speeding and the risk perception of speeding ($F(2, 1091) = 13{,}031$, $p \leq 0.05$). A subsequent analysis using Bonferroni's multiple comparison showed there were significant differences between not being sanctioned for speeding or just once and being sanctioned for speeding twice or more times.

However, in a 0 to 10 scale, drivers considered that the **probability of penalty** is 3.2, which means that their perception regarding this matter is low. All age groups had the same estimated probability of penalty, even though women ($F(1, 1060) = 22{,}084$, $p \leq 0.05$), drivers who had received a speeding ticket ($F(2, 1059) = 8{,}419$, $p \leq 0.05$), drivers using mainly urban zones, drivers who travel fewer kilometers per year, and those who had not been involved in a traffic crash ($F(1, 1060) = 5{,}772$, $p \leq 0{,}05$) are the ones who think the probability of penalty is higher.

In the group of drivers who had been sanctioned for speeding, 52.2% of them considered that the **penalty was appropriate**, while 41.4% believed it to be excessive and 6.5% thought it was not enough (Figure 3). The age and gender (or the rest of variables) did not have any influence on the assessment.

Finally, only 57.8% of drivers who received a penalty for speeding admitted they had **change their speeding behavior** as a consequence of this penalty, while 42.2% of

drivers in the same situation admitted they had not change it (Figure 4).

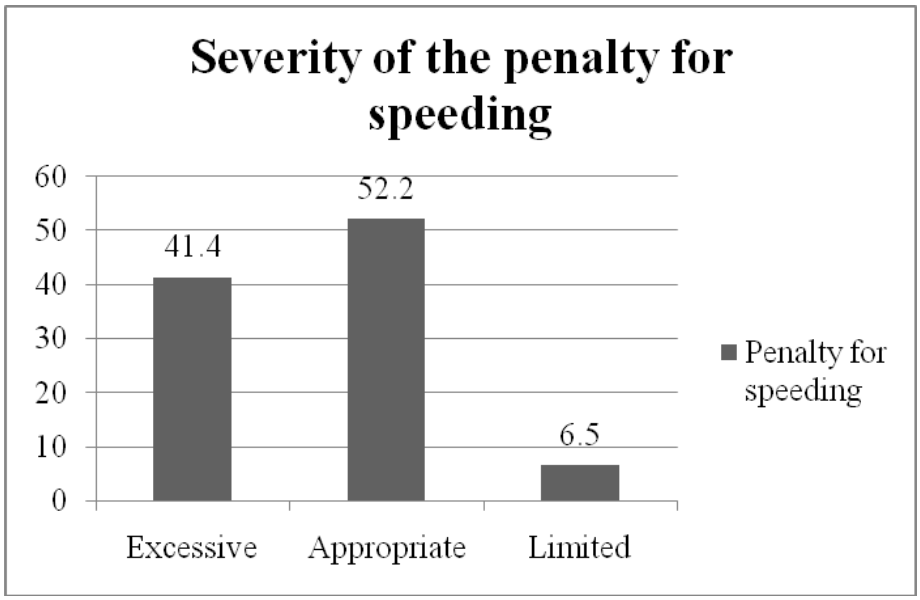


**Figure 3.** Percentage distribution of drivers according to the level of severity they stated regarding their penalty for speeding

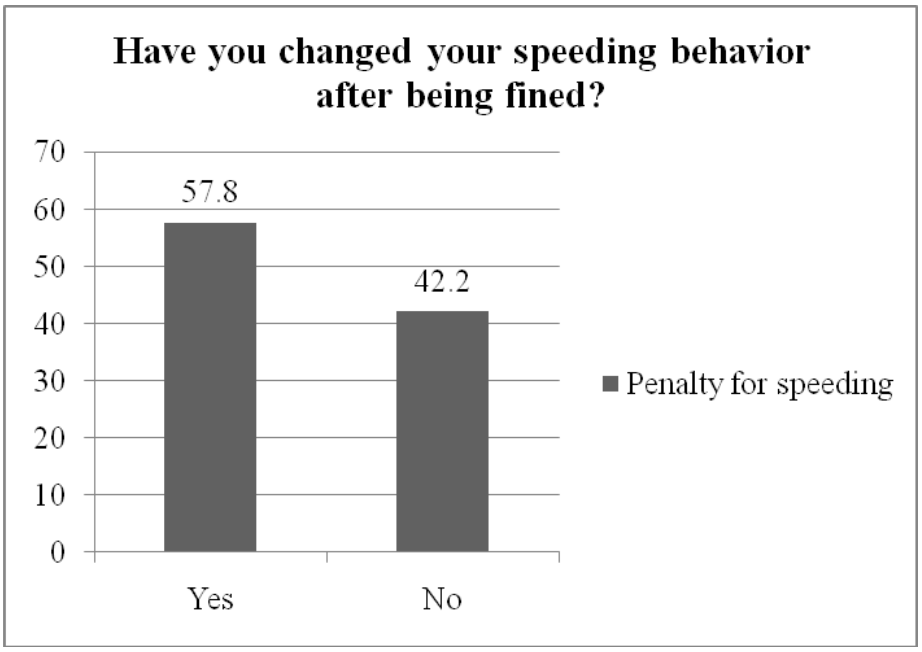


**Figure 4.** Percentage distribution of drivers according to whether they changed their speeding behavior or not after being fined

## 4. Discussion

The fact that a significant and worrying percentage of drivers (37.7%) admitted that they *always*, *almost always* or *sometimes* speed shows the urgent need to design and apply interventions to modify this behavior. It is important to remember that the behaviors that are the most common cause of traffic crashes must be the most addressed and corrected ones since not all behaviors have the same repercussion on road safety [10]. Therefore, speeding is one of the aspects that must be dealt with in order to reduce traffic crashes.

Regarding roads and the characteristics of the environment, it is necessary to improve the infrastructures, to establish acceptable and plausible speed limits, to have appropriate signs and vehicle engineering on the road, among other measures. It would be also convenient to use devices and technologies in the vehicle aimed at advising and controlling speeding in order to improve safety. However, there is a clear need to create and implement concrete strategies or education, awareness, and training campaigns aimed at drivers since they are the ones who have the final decision regarding the speeding behavior.

It is essential for the intervention strategies and programs to be adjusted to the profiles of the different groups of drivers according to demographic variables and driving experience. It is also important to include groups of drivers with multiple penalties and those who break the rules again (after they were sanctioned) in order to detect and influence their beliefs, perceptions, attitudes, motivations, and behaviors, as well as the cognitive, emotional, and social characteristics and conditions of every group of drivers.

Knowing the motives or reasons why drivers speed represents one of the main aspects upon which the interventions have to be designed and applied. In this

sense, it is clear that there is a need to design interventions that, from childhood and in both school and family context, not only focus on the informative aspect, but also on educational and learning aspects. The process of road safety education has to begin before breaking the traffic rule itself, so this way it would not be necessary to re-educate or re-train drivers in an authorized centre.

When drivers admitted they sped without realizing just because modern vehicles offer a slow speed feeling, it is clear that there is a need to design strategies aimed at promoting the habit of looking at the speedometer regularly, especially when leaving high speed roads. This may help to increase the correct knowledge of the speed limits (looking for signs in the intersections especially), to raise awareness on the consequences of speeding for other drivers, and to remember that the speed indicated in signs is the maximum speed allowed and not the speed in which drivers should drive.

Likewise, taking into account that drivers are not aware of the risks of speeding and the fact that road behaviors are characterized by turning into consistent habits in both time and different road types, it is essential to create interventions aimed at offering information of the technical reasons that justify the speed limits, the aspects that cause drivers to speed, the aspects that can be avoided, and the benefits of driving to a correct and appropriate speed, among others. The fact that drivers stated that the limits are too low or that the conditions allow speeding shows that drivers' expectations and mental schemes and models need to be more addressed in order to create interventions than the proper speed limits signs on the road.. Therefore, drivers' interpretation of the signs determines speed while they are driving. In this sense, it is also necessary to design self-explanatory roads to guide drivers to adapt speed to the road conditions, to make traffic more fluent, to avoid wrong behaviors, and to correct any mistake while driving.

The low probability of penalty estimated by all the participants, the favorable attitude towards the penalty that half of the sanctioned drivers for speeding showed, and the fact that the received penalty for this violation changed the behavior of 60% of these drivers proved the need to increase supervision of the police through traditional and automated methods (fixed or mobile cameras). In this sense, previous research has shown the need to implement several measures that contribute to safe road behavior [10].

However, in order for the supervision and control activity to be efficient, it is necessary that drivers be aware of the fact that there is a high risk of penalty when the speed limits are not respected. This means that, together with the increase of supervision and control, it is also necessary to increase drivers' risk perception of being sanctioned.

## 5. Conclusions

A significant and worrying percentage of Spanish drivers (37.7%) admitted they *always*, *almost always* or *sometimes* speed. However, it has been proved that these participants sped less than other drivers from other countries.

Thanks to other studies in other countries, it has also been concluded that male drivers between 18-24 years are the ones who speed more frequently. On the contrary, drivers from 45 years onwards in this study and other studies in other countries stated they speed less frequently.

Regarding the roads in which drivers usually sped, it was highways and freeways both in this study and also in foreign studies.

Therefore, the same tendencies are observed in different countries regarding different aspects related to speeding.

In general terms, it was concluded that drivers who speed are completely aware of the fact that they are breaking the traffic rules. Therefore, their speeding behavior is intentional in 80% of the cases. Secondly, it was also concluded that drivers are not aware of the risks of speeding since they justified their behavior by saying the speed limits are too low, the conditions on the roads allow doing so, or that it was a habit.

On the other hand, it is the risk of being involved in a traffic crash the reason why drivers respect the speed limits, so it can be concluded that the interventions aimed at reducing traffic crashes because of speeding are efficient.

The data analysis showed the limited probability of penalty estimated by drivers (3.2 in a 0 to 10 scale). So, it is shocking that a risk factor for traffic crashes such as speeding is perceived by drivers as an aspect with limited probability of penalty.

The fact that 21.8% of participants admitted they had been sanctioned for speeding at least once means that almost half of drivers who admitted speeding more or less frequently had been sanctioned. Therefore, this traffic violation has an actual moderate probability of penalty.

Finally, more than 50% of the drivers sanctioned for speeding considered the penalty was appropriate regardless of age and gender. In addition, around 60% of these drivers admitted they had changed their speeding habits as a result of the penalty, so this is a favorable attitude towards the speed limits and this penalty is also effective in terms of changing the behavior of some drivers.

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## Conflict of interests

The authors declare that they have no conflict of interest.

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